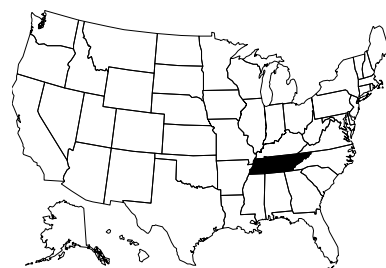


TENNESSEE

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Program Description

The Tennessee Department of Environment and Conservation's (TDEC) Division of Water Pollution Control (WPC), has an extensive bioassessment program. Benthic macroinvertebrate surveys are one of the primary tools used in assessing surface waters in the state. Biological data are instrumental in determining use-support and generating both the 305(b) and 303(d) reports. In-stream macroinvertebrate monitoring is included in many NPDES permits. Bioassessments are also used in the anti-degradation evaluation process. Biological data are used to measure improvements in water quality resulting from clean-up and habitat restoration efforts. Over 2,100 macroinvertebrate surveys have been conducted by TDEC since 1996.

TDEC has eight field offices each with at least two benthic biologist positions. In addition, there is a central laboratory facility in the Department of Health with seven aquatic biologists under contract to TDEC. These nine offices conduct the majority of macroinvertebrate stream surveys. Data from other agencies including the Tennessee Valley Authority (TVA), US Army Corps of Engineers (USACE), and USGS are also incorporated into the program.

In 1995, TDEC initiated an ecoregion delineation project resulting in the identification of 25 ecological subregions. Ninety-eight reference streams were targeted for monitoring. The macroinvertebrate community in these streams was sampled seasonally for three years and on a five-year cycle by watershed starting in 1999. These data were used to develop regional numeric biocriteria that have been proposed for inclusion in the 2002 triennial review of water quality standards. The proposed numeric criteria are already being used to help interpret narrative criteria. In addition, reference stream data were used to develop guidelines for biological reconnaissance as a screening tool during watershed assessments.

Future goals of the bioassessment program include:

- Continue to monitor ecoregional reference streams and locate additional streams to further refine biocriteria and better identify reference condition.
- Conduct additional bioassessments as means to increase TDEC's percentage of assessed streams for national reporting purposes.
- Develop a macroinvertebrate tolerance index specific to Tennessee.
- Develop biocriteria for large rivers, wetlands and reservoirs.
- Continue to use benthic data as a measure of improvement in water quality.

Documentation and Further Information

Arnwine, D.H. and G. M. Denton. 2001. *Development of Regionally-Based Interpretations of Tennessee's Existing Biological Integrity Criteria*. Tennessee Department of Environment and Conservation, Division of Water Pollution Control. Nashville, TN

Arnwine D.H. and G. M. Denton. 2001. *Habitat of Least Impacted Streams in Tennessee*, Tennessee Department of Environment and Conservation, Division of Water Pollution Control, Nashville, TN

Arnwine, D.H., J.I. Broach, L.K. Cartwright and G.M. Denton. 2000. *Tennessee Ecoregion Project*. Tennessee Department of Environment and Conservation, Division of Water Pollution Control. Nashville, TN.

Denton, G.M., A.D. Vann, and S.H. Wang. 2000. *The status of Water Quality in Tennessee: Year 2000 305(b) Report*. Tennessee Department of Environment and Conservation, Division of Water Pollution Control. Nashville, TN.

Griffith, G.E., J.M. Omerik and S. Azevedo. 1997. *Ecoregions of Tennessee*. EPA/600/R-97/022. NHREEL, Western Ecological Division, U.S. Environmental Protection Agency, Corvallis, Oregon.

Quality System Standard Operating Procedure for Macroinvertebrate Stream Surveys. 2002. Tennessee Department of Environment and Conservation, Division of Water Pollution Control. Nashville, TN.

DRAFT Year 2002 303(d) List, July 2002: <http://www.state.tn.us/environment/wpc/2002303ddraft.pdf>

TDEC General Water Quality Criteria, rev. October 1999: <http://www.state.tn.us/sos/rules/1200/1200-04/1200-04-03.pdf>

TDEC Use Classifications for Surface Waters, rev. October 1999: <http://www.state.tn.us/sos/rules/1200/1200-04/1200-04-04.pdf>

2001 Triennial Review of Water Quality Standards, Staff Proposal: http://www.state.tn.us/environment/wpc/tr_wqs.pdf

Other TDEC publications, including 305(b) reports, can be found online at: <http://www.state.tn.us/environment/wpc/publicat.htm>

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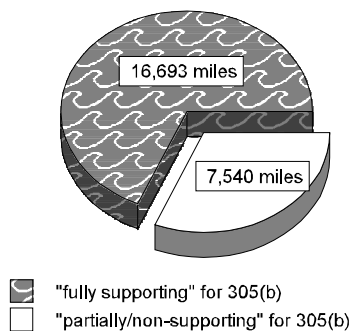
Programmatic Elements

Uses of bioassessment within overall water quality program	<input checked="" type="checkbox"/>	problem identification (screening)
	<input checked="" type="checkbox"/>	nonpoint source assessments
	<input checked="" type="checkbox"/>	monitoring the effectiveness of BMPs
	<input checked="" type="checkbox"/>	ALU determinations/ambient monitoring
	<input checked="" type="checkbox"/>	promulgated into state water quality standards as biocriteria
	<input checked="" type="checkbox"/>	support of antidegradation
	<input checked="" type="checkbox"/>	evaluation of discharge permit conditions
	<input checked="" type="checkbox"/>	TMDL assessment and monitoring
Applicable monitoring designs	<input type="checkbox"/>	other:
	<input checked="" type="checkbox"/>	targeted (i.e., sites selected for specific purpose) (<i>comprehensive use throughout jurisdiction</i>)
	<input checked="" type="checkbox"/>	fixed station (i.e., water quality monitoring stations) (<i>comprehensive use throughout jurisdiction</i>)
	<input type="checkbox"/>	probabilistic by stream order/catchment area
	<input checked="" type="checkbox"/>	probabilistic by ecoregion, or statewide (<i>special projects only</i>)
	<input checked="" type="checkbox"/>	rotating basin (<i>comprehensive use throughout jurisdiction</i>)
	<input type="checkbox"/>	other:

Stream Miles

Total miles	60,187
<i>(Determined using RF3)</i>	
Total perennial miles	—
Total miles assessed for biology	24,233
fully supporting for 305(b)	16,693
partially/non-supporting for 305(b)*	7,540
listed for 303(d)*	14,333
number of sites sampled	2,202
number of miles assessed per site	—

24,233 Miles Assessed for Biology



*The stream miles "partially/non-supporting" for 305(b) are significantly less than the stream miles listed for 303(d) because the last 303(d) list was revised in 1998 while the 305(b) reflects assessments through 2000. The 2002 draft 303(d) and 305(b) reports are in agreement.

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Single Aquatic Life Use
ALU designations in state water quality standards	One designation: Fish and Aquatic Life
Narrative Biocriteria in WQS	Formal/informal numeric procedures used to support narrative biocriteria are found in the <i>Development of Regionally-Based Numeric Interpretations of Tennessee's Narrative Biological Integrity Criterion</i> (see documentation).
Numeric Biocriteria in WQS	under development (Tennessee water quality standards will be changed in 2002 to reflect proposed numeric criteria for 15 bioregions. Numeric biocriteria, proposed for inclusion in the new WQS are as follows, "Multimetric index using 7 metrics - TR, EPT, %EPT, %OC, NCBI, %DOM and % Clingers". Scoring criteria is based on 25% of reference condition. Reference condition is based on ecoregion reference data at the 90 th percentile. Ecoregions have been grouped into 15 bioregions. Expected index score is calibrated to each bioregion and by season where appropriate.")
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	<input checked="" type="checkbox"/> assessment of aquatic resources <input checked="" type="checkbox"/> cause and effect determinations <input checked="" type="checkbox"/> permitted discharges <input checked="" type="checkbox"/> monitoring (e.g., improvements after mitigation) <input checked="" type="checkbox"/> watershed based management
Uses of bioassessment/biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	Nonpoint source section, field offices - office by office use, not systematic/statewide use

*TR = total richness; EPT = Ephemeroptera (mayflies), Plecoptera (stoneflies), Trichoptera (caddisflies); OC = Orthocladiinae of Chironomidae; NCBI = North Carolina Biotic Index; DOM = dominant taxa.

Reference Site/Condition Development

Number of reference sites	98 total
Reference site determinations	<input type="checkbox"/> site-specific <input type="checkbox"/> paired watersheds <input checked="" type="checkbox"/> regional (aggregate of sites) <input type="checkbox"/> professional judgment <input type="checkbox"/> other:
Reference site criteria	Reference database of chemical, habitat and biometrics based on monitoring of regional reference sites since 1996. Reference sites must fall within 90 th percentile for chemical, biological and habitat parameters compared to existing reference database. Disturbed sites are those under 75% comparable to reference condition for biological and habitat, above the 90 th percentile (reference) for nutrients (and show impaired biology), or exceed numeric criteria for other specified parameters.
Characterization of reference sites within a regional context	<input type="checkbox"/> historical conditions <input checked="" type="checkbox"/> least disturbed sites <input type="checkbox"/> gradient response <input type="checkbox"/> professional judgment <input type="checkbox"/> other:
Stream stratification within regional reference conditions	<input checked="" type="checkbox"/> ecoregions (or some aggregate) <input type="checkbox"/> elevation <input type="checkbox"/> stream type <input type="checkbox"/> multivariate grouping <input type="checkbox"/> jurisdictional (i.e., statewide) <input type="checkbox"/> other:
Additional information	<input checked="" type="checkbox"/> reference sites linked to ALU <input type="checkbox"/> UD reference sites/condition referenced in water quality standards (<i>WQS under revision</i>) <input checked="" type="checkbox"/> some reference sites represent acceptable human-induced conditions

Field and Lab Methods

Assemblages assessed	<input checked="" type="checkbox"/>	benthos (<i>100-500 samples/year; single season, multiple sites - watershed level</i>)
	<input type="checkbox"/>	fish
	<input type="checkbox"/>	periphyton
	<input type="checkbox"/>	other:
Benthos		
sampling gear		dipnet and kick net (1 meter); 500 - 600 micron mesh
habitat selection		riffle/run used for biocriteria in high gradient streams; rooted bank used for biocriteria in low gradient streams (Note that four jab multihabitat bioreconnaissances are used for general water quality assessments, not comparable to biocriteria)
subsample size		200 count
taxonomy		genus
Habitat assessments		
		visual based; performed with bioassessments
Quality assurance program elements		
		standard operating procedures, quality assurance plan, periodic meetings and training for biologists, sorting and taxonomic proficiency checks, specimen archival

Data Analysis and Interpretation

Data analysis tools and methods	<input checked="" type="checkbox"/>	summary tables, illustrative graphs
	<input checked="" type="checkbox"/>	parametric ANOVAs
	<input checked="" type="checkbox"/>	multivariate analysis
	<input checked="" type="checkbox"/>	biological metrics (<i>aggregate metrics into an index</i>)
	<input type="checkbox"/>	disturbance gradients
	<input type="checkbox"/>	other:
Multimetric thresholds		
transforming metrics into unitless scores		90 th or 10 th percentile of reference population depending on direction of metric
defining impairment in a multimetric index		25% of 90 th (or 10 th) percentile of reference population
Multivariate thresholds		
defining impairment in a multivariate index		Used for development of initial criteria, not for current assessments
Evaluation of performance characteristics	<input checked="" type="checkbox"/>	repeat sampling (<i>replicate samples at 10% of reference sites by different teams</i>)
	<input checked="" type="checkbox"/>	precision (<i>two samples collected at 10% of sites by two teams</i>)
	<input checked="" type="checkbox"/>	sensitivity (<i>standard level of identification, compare metric scores to known impacts</i>)
	<input checked="" type="checkbox"/>	bias (<i>compared different sample/habitat types</i>)
	<input checked="" type="checkbox"/>	accuracy (<i>10% of samples QC for taxonomy and sorting efficiency</i>)
Biological data		
Storage		MS Access; semi-quantitative samples (taxa lists and metric scores) are stored in EDAS database and bioreconnaissance results are stored in Water Quality Database (taxa lists are in paper files). The eventual goal is for data to be sent to STORET. Assessment results are stored in an Assessment Database.
Retrieval and analysis		EDAS, Statview, and multivariate statistical package